PTO

Description

Heat exchanger

The invention relates to a heat exchanger, having at least one heat exchanger block and an insulating vessel which surrounds the heat exchanger, in which securing means are provided for securing the heat exchanger block hanging in the insulating vessel, and to its use in a low-temperature air fractionation plant.

During the low-temperature fractionation of air, the charge air which is to be fractionated has to be cooled to the process temperature. This usually takes place through indirect heat exchange between the charge air and the product streams obtained in the air fractionation plant. In plants in which large quantities of air are processed, the principal heating exchanger is produced by a plurality of heat exchanger blocks connected in parallel. The individual heat exchanger blocks are in this case generally designed as plate-type heat exchangers.

The thermal insulation of the principal heat exchanger is provided by introducing the heat exchanger into a thermally insulated insulating vessel, known as a coldbox. Various methods are known for securing the heat exchanger or the individual heat exchanger blocks in the insulating vessel.

Firstly, it is known to place the heat exchanger blocks on uprights or supports on the floor or foundation of the insulating housing. In some cases, profiled sections are also fitted to two opposite sides of the heat exchanger block, and these profiled sections are then laid on top of supports which run transversely through the insulating space and hold the heat exchanger block. It is also possible to fit tie-rods on

laterally arranged profiled sections, with the aid of which rods the heat exchanger is suspended from ceiling supports of the insulating space.

Furthermore, WO 99/11990 describes holding the heat exchanger block at the warm end, i.e. in the upper region, by means of supporting brackets and clamping it at an angle in the insulating space at the cold end by means of elements in rope form.

A factor which all these securing methods have in common is that the heat exchanger block is secured rigidly in the insulating space. However, when the plant is started up or in the event of load changes, the pipelines which are connected to the heat exchanger block undergo considerable changes in length, of up to 4 mm per metre of pipe length, for temperature reasons. In order, for example, during cooling to avoid cracks or other damage to the heat exchanger block or the pipelines caused by pipe shrinkage, therefore, it has hitherto been necessary to provide line loops as shrinkage compensation or to reinforce, at high cost, the connection pieces on the heat exchanger block. As a result, the pipe length required for piping increases, the space taken up by the piping rises and the piping becomes more complicated.

Therefore, one object of the present invention to develop a heat exchanger which is secured in the insulating vessel in such a way that the piping becomes as simple as possible and the line loops for shrinkage compensation are avoided or at least minimized. Upon further study of the specification and appended claims, other objects and advantages of the invention will become apparent.

According to the present invention, there is provided a heat exchanger of the type described in the introduction in which the heat exchanger block is arranged movably in the insulating vessel.

According to the invention, the heat exchanger block is secured in such a way that thermally produced changes in the pipelines connected to the heat exchanger block are compensated for by a change in position of the block. For example, when the plant is cooling, the heat exchanger block is moved with the contracting pipelines.

It is preferable for the heat exchanger block to be secured in the insulating vessel in such a way that its lower end can move in at least two spatial directions. It is particularly preferred for the heat exchanger block to be suspended in such a manner that it can move freely above its centre of gravity.

It is usual for the warm charge air to be supplied to the upper end of the heat exchanger block and the cold product gases to be supplied to the lower end of the heat exchanger block. Accordingly, during start-up or in the event of load changes, only the pipelines which are connected to the lower, cold end of the heat exchanger block undergo significant changes in length, since the temperature changes at the warm end are only minor. The fact that the heat exchanger block is suspended above its center of gravity means that it can be moved relatively easily at its lower end. Therefore, only small forces act on the pipelines which are connected to the lower end and, through their contraction, cause the movement of the heat exchanger block. Unacceptably high stresses on the pipelines are thereby avoided.

The invention has proven particularly useful in a heat exchanger which comprises at least two, preferably at least four heat exchanger blocks. The invention is particularly suitable for heat exchangers which comprise eight or ten heat exchanger blocks in two rows of in each case four or five blocks. Relatively large heat exchangers, which comprise a plurality of heat

exchanger blocks, require complex piping in order to distribute the charge air which is to be cooled and the product streams which are guided in countercurrent flow to the individual heat exchanger blocks.

The line loops which have hitherto been required as contraction lengths also make piping more difficult and, in particular, increase the space which it requires. Consequently, it is also necessary to provide larger insulating vessels, which leads to further increases in the costs of a plant of this type.

The inventive way of securing the heat exchanger blocks simplifies piping, reduces the size of the insulating vessel and therefore leads to a considerable reduction in costs. This is true in particular if the individual heat exchanger blocks have feed lines and/or discharge lines which lead into a common collection line.

It is preferable to provide securing means which have joints, so that the heat exchanger block can be moved about the joint axes. An articulated suspension of this type can be achieved with relatively little technical outlay and has proven particularly successful in practice.

Brief Description of the Drawings

The invention and further details of the invention are explained in more detail below with reference to exemplary embodiments illustrated in the drawings, in which:

Figure 1 diagrammatically depicts the suspension of a heat exchanger according to the invention, and

Figure 2 shows a side view of Figure 1.

Fig. 3 illustrates a coldbox, indicated with reference number 11, with two heat exchanger blocks (1) hanging on a double-T support (8) which is fixed within the coldbox (11).

Fig. 4 is a top view of a coldbox (11) enclosing six heat exchanger blocks (1) which are hanging on three double-T supports (8). The figure shows a discharge pipeline connected to the cold end of each heat exchanger block (I) with all discharge pipelines leading to one common connection line (reference number 12).

Fig. 5 illustrates a heat exchanger block (I) which is directly fixed to the coldbox (II) without using a double-T support (8).

Detailed Description of the Drawings

Figures 1 and 2 show the upper end of a heat exchanger block 1, which is used in the principal heat exchanger of a low-temperature air fractionation plant. The principal heat exchanger as a whole comprises a plurality of heat exchanger blocks 1 of this type connected in parallel.

The heat exchanger block 1 is up to 240 cm wide. A connector/distributor 2, known as a header, is arranged on the heat exchanger block 1, from which header one or more pipelines (not shown) lead away.

Aluminium plates 3, which project upwards beyond the header 2, are secured to the heat exchanger block 1 on two opposite sides. A substantially triangular steel plate 4 or a steel support which is designed according to static demands is arranged perpendicular to the aluminium plates 3, above the header 2, and is articulately connected to the two aluminium plates 3 at two corners by means of bolts 5. The steel plate 4 can move relative to the heat exchanger block 1 about the axis 6 formed by the extension of the two bolts 5.

At the third corner of the steel plate 4 there is a further joint 7. The steel plate 4 is suspended by means of the joint 7 from a double-T support 8, which is secured in the coldbox (not shown) and supports the heat exchanger block 1. The joint 7 allows movement in the plane of the steel plate 4 or about an axis 9 perpendicular to the steel plate 4.

Therefore, the heat exchanger block 1 is articulately suspended in such a manner that it can rotate about two axes 6, 9 which are perpendicular to one another. The arrangement of the two aluminium plates 3 and of the steel plate 4 is selected in such a way that the

suspension point 10 is situated vertically above the center of gravity of the heat exchanger block 1.

In addition, a horizontal movement of the heat exchanger block 1 can be absorbed by means of a suitably selected distance between the aluminium plates 3 and the steel plate 4.

The joint 7 is arranged in such a way that the axis 9 is matched to the project-specific requirements, i.e. to the pipe stresses which occur or can be calculated for a specific design of the heat exchanger.

One or more pipelines (not shown) for supplying and discharging the fluid streams which are to be brought into heat exchange with one another are arranged at the lower end of the heat exchanger block 1. In the event of load changes and when the plant is being heated and cooled down, these pipelines undergo changes in length of approximately 3 to 4 mm per meter of pipeline length, for thermal reasons. The fact that, according to the invention, the heat exchanger block 1 is suspended above its center of gravity means that it is moved by even relatively minor forces acting on its lower end. The movement of the heat exchanger block 1 compensates for the thermally induced changes in pipe length, so that there is no need for pipe loops for compensating for contraction in the pipelines.

The preceding examples can be repeated with similar success by substituting the generically or specifically described reactants and/or operating conditions of this invention for those used in the preceding examples. Also, the preceding specific embodiments are to be construed as merely illustrative, and not limitative of the remainder of the disclosure in any way whatsoever.

The entire disclosure of all applications, patents and publications, cited above and below, and of corresponding German application 10110704.8, are hereby incorporated by reference.

From the foregoing description, one skilled in the art can easily ascertain the essential characteristics of this invention, and without departing from the spirit and scope thereof, can make various changes and modifications of the invention to adapt it to various usages and conditions.